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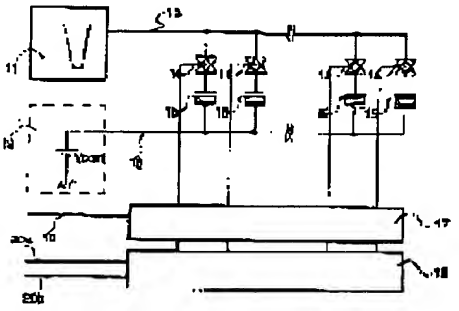
(21)Application number : 09-045033 (71)Applicant : CITIZEN WATCH CO LTD
(22)Date of filing : 28.02.1997 (72)Inventor : KOMINE SHINICHI

(54) INK-JET HEAD DRIVING CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: To make an IC utilizable as a switch means by applying a driving signal changing with a voltage of a specific value or larger to one electrode of an electrostriction element, impressing a voltage of a specific value or larger to the other electrode, applying a voltage in a forward, rearward direction to a polarization direction by a potential difference, and expanding, compressing the electrostriction element.



SOLUTION: A positive voltage not smaller than 0V output from a driving waveform generation circuit 11 is input to input terminals of a plurality of transfer gates(TG) 14 through a common line 13. The other terminals of the TG 14 are connected to an electrostriction element 15. A driving waveform is controlled to be applied and not to be applied to the electrostriction element 15 by switching ON/OFF the TG 14. The other electrode of the electrostriction element 15 is a common electrode 16 connected to electrodes of a plurality of the other electrostriction elements. The common electrode 16 is connected to a DC power source 12 outputting 0V or more. When a potential of the driving waveform is higher than a potential Vcom of the common electrode 16 of the electrostricion element 15, the voltage is applied in a forward direction to a polarization direction. When the potential of the common electrode is higher, the voltage is applied in a rearward to the polarization direction. As a result, the electrostriction element 15 is expanded or compressed.

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	2/055		Ｈ０４Ｎ	1/034	
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(71)出願人　000001960
シチズン時計株式会社
東京都新宿区西新宿２丁目１番１号

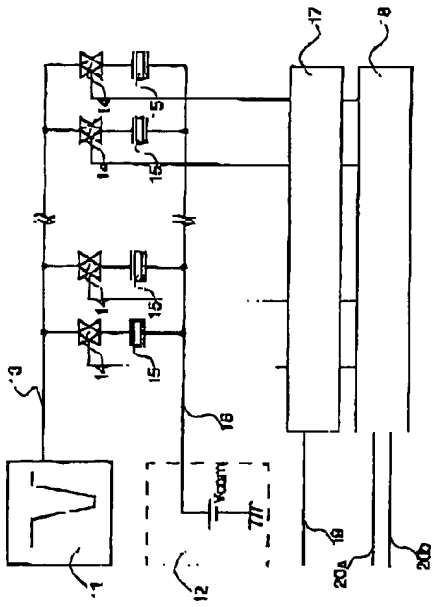
(72)発明者　小峰　伸一
埼玉県所沢市大字下富字武野840番地　シチズン時計株式会社技術研究所内

(54)【発明の名称】　インクジェットヘッド駆動回路

(57)【要約】

【課題】　駆動波形がマイナス電位の状態が発生するため、当然ＩＣの入力端子にもマイナス電圧がかかり、入力端子から大電流が流れＩＣが破壊されてしまう恐れがあり、大きなコストアップになる。

【解決手段】　電歪素子の一方の電極に０Ｖ以上の電圧で変化する駆動信号を与え、もう一方の電極にも０Ｖ以上の電圧を印加し、互いの電極の電位差により分極方向に対し正方向と逆方向に電圧を印加し、電歪素子を伸縮させることを特徴とするインクジェットヘッド駆動回路である。



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【特許請求の範囲】

【請求項1】　インクを電歪素子で押圧してインクをノズルより吐出せしめて文字および図形を印字するインクジェットヘッド駆動回路で電歪素子に印加する電圧が電歪素子の分極方向に対して正方向と逆方向に印加するインクジェットヘッド駆動回路であって、電歪素子の一方の電極に0V以上の電圧で変化する駆動信号を与え、もう一方の電極にも0V以上の電圧を印加し、互いの電極の電位差により分極方向に対し正方向と逆方向に電圧を印加し、電歪素子を伸縮させることを特徴とするインクジェットヘッド駆動回路

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明はインクジェットヘッド駆動回路に関するものである。

【0002】

【従来の技術】まずインクジェットヘッドについて簡単に説明する。図5はインクジェットヘッドの構造の一例である。インクが充填されている圧力室51の一面はダイヤフラム54が接着され、また圧力室と反対の面には電歪素子15が接着されている。図に示すように、電歪素子は駆動波形を印加する際に、図6bの様に分極方向に印加した場合、電歪素子は電極に垂直の方向に伸び、＊

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＊圧力室の容積は収縮され、インクが吐出される。また、図6cのように逆方向に印加した場合は縮み、圧力室は収縮されインクが注入される。

【0003】従来では図7のように、インクの吐出、及び注入は電歪素子に正の電圧を印加し、伸ばして吐出（a）。そして0Vにして、電歪素子が歪んでいない状態に戻す時にインクを注入（b）するのである。

【0004】それに比較して、図8のように電歪素子に負の電圧を印加して、縮む方向にも歪ませてやれば（b）、その分正の電圧を低くすることができる。従来の場合では正の電圧が大きすぎて、電歪素子が伸びようとした時にダイヤフラムが伸びされず、拘束を受け、理想的な歪みを得られず、インク吐出に対しての損失があった。負の電圧を印加し、電歪素子を縮ませることで、その分伸びる量を小さくし、0Vからの歪み量を小さくすることで、ダイヤフラムからの拘束を受けずに、インクを吐出させることができる。下記のデータは従来の駆動に対して、正負トータル的に同じ電圧を印加した場合のインク吐出特性の違いである。同じ電圧でも吐出速度と液滴径が異なるのが分かる。

【0005】

【表1】

駆動方法	正電圧	負電圧	駆動電圧	吐出速度	液滴径
従　来(正のみ)	40v	0v	40v	6．5m／s	60μm
本発明(正負)	30v	10v	40v	6．5m／s	62μm

【0006】このように、電歪素子に分極方向に対して、正方向と逆方向に電圧を印加することで、電歪素子が伸びと縮みの両方向に歪むため、ダイヤフラムが上下に動くので、伸びる方向のみで歪ませるより、ダイヤフラムの拘束を受けることがないので、効率良く吐出させることができる。上述した電歪素子の駆動を実現する、従来のインクジェットヘッドの駆動回路を図9に示す。電歪素子15の一方の電極はGNDに接続（0V）されており、もう一方の電極に駆動波形を発生する、波形発生回路91が接続されている。駆動波形は図10に示すように、0V（GND）に対して正の電位から負の電位まで変位する。駆動波形が正の電位の時は、分極方向に対して正方向の電圧が印加されているので、電歪素子は伸び、負の電位の時は、逆方向の電圧が印加されているので、電歪素子は縮む。例えば特開昭56－113473号に記載されている回路もそうである。

【0007】波形発生回路91は第一の方法として、図11のようにDAコンバータ21、オペアンプ22、トランジスタ23で構成され、DAコンバータから駆動波形が発生され、オペアンプによって実際の駆動電圧に電圧増幅され、トランジスタのエミッタフォロワ出力により、電流増幅される。

【0008】また、上述した第一の方法ではDAコンバータ、OPアンプ等、部品コストが上がるので、第二の方法として図12の様に、コンデンサーに充放電する回路が考えられる。駆動波形をコンデンサー35に充放電回路33、34によって形成し、トランジスタ　23によって電流増幅するものである。ただし、充放電回路を

制御する信号は31、32にCMOS、もしくはTTLレベルで入力されるため、レベルシフタ121等電圧変換器が必要になり、コストアップにつながる。

【0009】第一、第二どちらの方法にしても、駆動電圧が負から正に変化するので、電歪素子に分極方向に対して、正逆両方に電圧を印加することができる。

【0010】

【発明が解決しようとする課題】しかしながら、上述した従来の駆動回路では、駆動波形が負の電位の状態が発生するため、電歪素子が単数の場合は問題ないが、オンデマンド式インクジェットヘッドの様に複数の電歪素子を用いて、駆動波形の電歪素子への印加、非印加を制御し、文字等を印字する場合、電歪素子　へ駆動電圧の印加、非印加のスイッチング手段が必要になる。スイッチング手段としては、コスト、スイッチング速度等を考慮すると、半導体スイッチが好ましい。例えば図13の様にTG14でスイッチング手段を構成することが容易に考えられるが、コスト、実装スペース等を考えると、IC（Integrated-Circuit）での構成が考えられる。ICはCPUもしくはゲートアレイ等でコントロールされるため、基本的に0V以上で動作する。しかし、駆動波形がマイナス電位の状態が発生するため、当然ICの入力端子にもマイナス電圧がかかり、入力端子から大電流が流れICが破壊されてしまう恐れがある。これではICは使えず、ディスクリート部品を使用しなければならないため、大きなコストアップになる。

【0011】

【課題を解決するための手段】上記問題を解決するため本発明のインクジェットヘッドの駆動回路は電歪素子の一方の電極に0V以上の電圧で変化する、駆動信号を与え、もう一方の電極にも0V以上の電圧を印加し、互いの電極の電位差により、分極方向に対し、正方向と逆方向に電圧を印加し、電歪素子を伸縮させることを特徴とする。

【0012】本発明のインクジェットヘッドの駆動回路によれば、駆動波形は電歪素子の分極方向に対して、正方向、逆方向のどちらの電圧印加の場合でも、0Vに対して負の電位の状態になることはないので、電歪素子への印加、非印加を制御するスイッチ手段に従来と同じようにICを使用することが出来、インクの吐出効率が上がる、電歪素子の分極方向に正逆に印加する事を、安価なインクジェットヘッドの駆動回路で実現できる。

【0013】

【発明の実施の形態】以下、本発明によるインクジェットヘッドの駆動回路の実施の形態を図面に基づいて説明する。図1は本発明によるインクジェットヘッドの駆動回路の実施例を示す回路図である。　は電歪素子に印加する駆動波形を生成する回路で、最大印字周波数で、駆動波形が発生される。駆動波形発生回路の出力はコモン

線　を通して、複数のTG14の入力端子へ接続される。それぞれのTG14のもう一方の端子は電歪素子15の電極に接続され、TGをON／OFFすることで、電歪素子への駆動波形の印加、非印加を制御する。TGのコントロールはCMOS、もしくはTTLレベルでシフトレジスタ18にデータ転送クロック20bに同期して、シリアル印字データ20aが入力される。シフトレジスタから出力された印字データはラッチ回路17に入力され、ラッチ信号19によってラッチ回路に記憶される。ラッチ回路の出力はそれぞれ、TG14のゲート入力に接続される。

【0014】電歪素子のもう一方の電極は他の複数の電歪素子の電極と接続されているコモン電極16である。コモン電極16は0V以上を出力するDC電源12に接続される。コモン電極10と駆動波形の電位の関係は図4のようになっており、電歪素子のコモン電極の電位Vcomに対して、駆動波形の電位が高い場合（A）は分極方向に正方向に印加され、コモン電極の電位の方が高い場合（B）は分極方向と逆方向に印加される。

【0015】駆動波形発生回路11、及びコモン電極16のDC電源12の出力Vcomともに0V以上の正の電圧であるため、TG14には負の電圧が入力されることはない。また、コモン電極用のDC電源が必要になる以外は、マイナス電圧変換器等のようなものは必要とせず、余計なコストはかからない。

【0016】図2、図3は図1の回路の波形発生回路11の第1の例と第2の例の詳細図である。基本的には従来例で示した、波形発生回路91と同じであるが、負の電圧を使用していないところが異なる。

【0017】図2はDAコンバータを使用した方式であり、駆動波形はDAコンバータ21によって、0～5vの範囲で出力され、OPアンプ　22によって実駆動波形に電圧増幅される。出力に電流増幅のためのPush-Pullエミッタフォロワ回路23が接続される。駆動波形は0～Vhの範囲で変位する。

【0018】図3はコストダウンを目的とした、コンデンサーを用いた方式である。コンデンサー3bと充放電回路33、34、電流増幅トランジスタ23で構成される。コンデンサーは0～Vhの範囲で充放電される。

【0019】本発明の駆動回路は基本的には、電歪素子の分極方向に対して、正方向のみ電圧を印加する駆動方法を実現する駆動回路にコモン電極用DC電源を追加するだけで、分極方向に対し、正逆両方向の駆動が可能になり、効率の良いインク吐出を可能にするものである。

【0020】

【発明の効果】本発明のインクジェットヘッドの駆動回路によると上記した如く、駆動波形は電歪素子の分極方向に対して、正方向、逆方向のどちらの電圧印加の場合でも、0Vに対して負の電位の状態になることはないので、電歪素子への印加、非印加を制御するスイッチ手段

に従来と同じように1Hを使用することが出来、インクの吐出効率が上がる、電歪素子の分極方向に正逆に印加する事を、安価なインクジェットヘッドの駆動回路で実現できる。

【図面の簡単な説明】

【図1】本発明の実施例を示すインクジェットヘッドの駆動回路である。

【図2】本発明の実施例を示すインクジェットヘッドの駆動回路の波形発生回路の第1の例である。

【図3】本発明の実施例を示すインクジェットヘッドの駆動回路の波形発生回路の第2の例である。

【図4】本発明の実施例を示すインクジェットヘッドの駆動回路の駆動波形の1例を示す。

【図5】従来のインクジェットヘッドの構造図である。

【図6】電歪素子の分極方向に対して、正方向と逆方向に電圧を印加した時の歪みの様子を示す。

【図7】電歪素子の分極方向に対して、正方向のみ電圧を印加して、インクの吐出と注入を行う場合を示す。

【図8】電歪素子の分極方向に対して、正方向と逆方向に電圧を印加して、インクの吐出と注入を行う場合を示す。

【図9】従来の電歪素子の分極方向に対して、正方向と逆方向に電圧を印加する、インクジェットヘッドの駆動回路である。

【図10】従来の電歪素子の分極方向に対して、正方向と逆方向に電圧を印加する、インクジェットヘッドの駆動回路の駆動波形である。

【図11】従来の電歪素子の分極方向に対して、正方向と逆方向に電圧を印加する、インクジェットヘッドの駆動回路の波形発生回路の第1の例である。

【図12】従来の電歪素子の分極方向に対して、正方向と逆方向に電圧を印加する、インクジェットヘッドの駆動回路の波形発生回路の第2の例である。

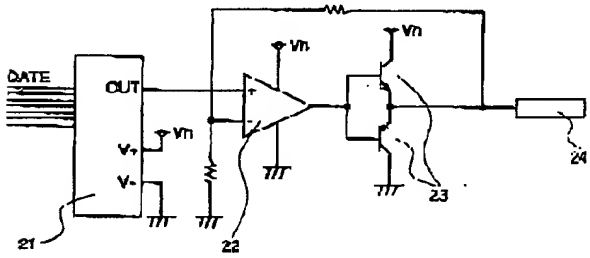
【図13】従来の電歪素子の分極方向に対して、正方向＊

＊と逆方向に電圧を印加する、インクジェットヘッドの駆動回路で複数の電歪素子の駆動を制御する回路の1例である。

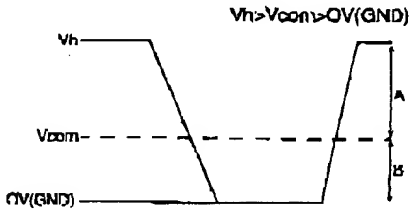
【符号の説明】

11　本発明の駆動回路の波形発生回路
12　コモン電極用DC電源
13　駆動波形コモン線
14　TG（トランスファーゲート）
15　電歪素子
16　コモン電極
17　ラッチ回路
18　シフトレジスタ
19　ラッチ信号
20a　シリアル印字データ
20b　転送クロック
21　DAコンバータ
22　OPアンプ
23　電流増幅トランジスタ
24　波形発生回路出力端子
31　充電回路入力
32　放電回路入力
33　充電回路
34　放電回路
35　コンデンサー
51　圧力室
52　インク
53　ノズル板
54　ダイヤフラム
55　電歪素子の電極
56　電歪素子の電極
57　基台
91　従来の駆動回路の波形発生回路
121　レベルシフタ（電圧変換器）

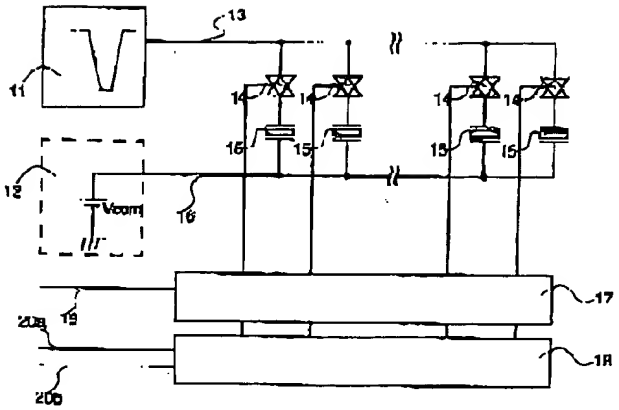
【図2】



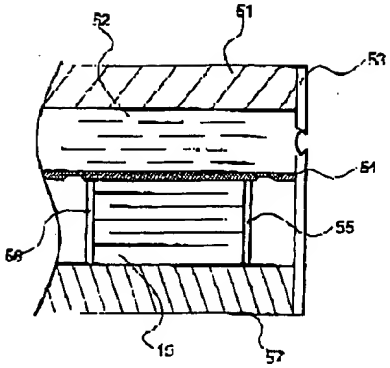
【図4】



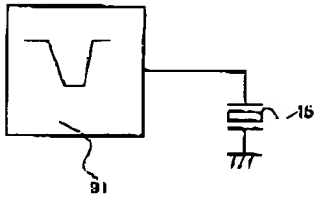
【図1】



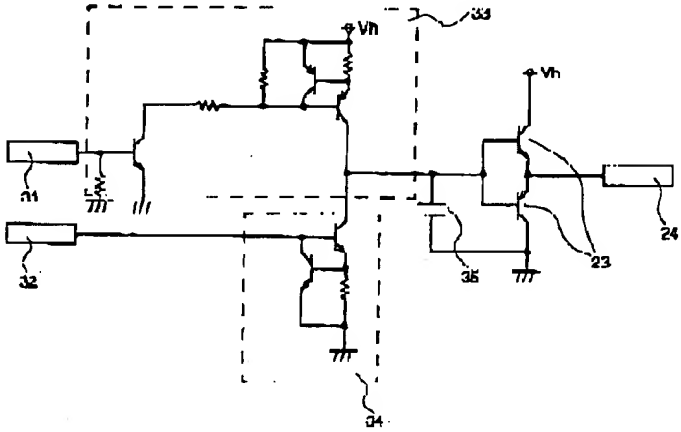
【図5】



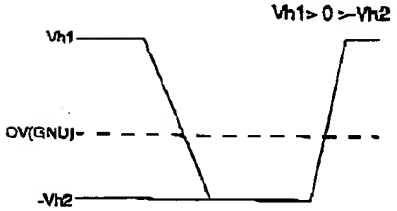
【図8】



【図3】



【図10】



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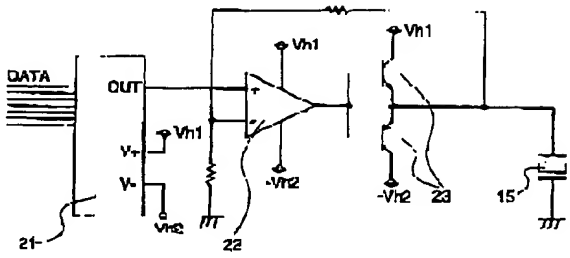

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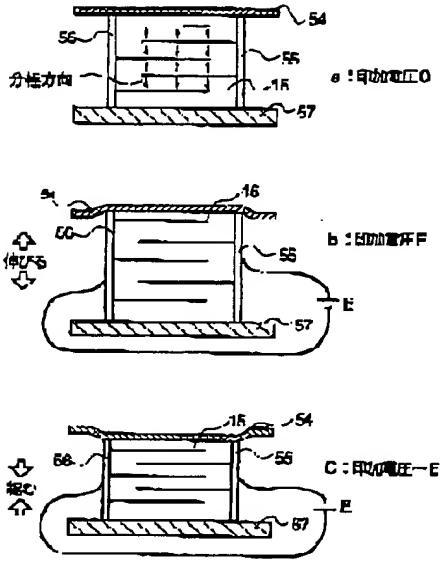
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分極方向
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57
a：印加電圧0
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16
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E
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16
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E
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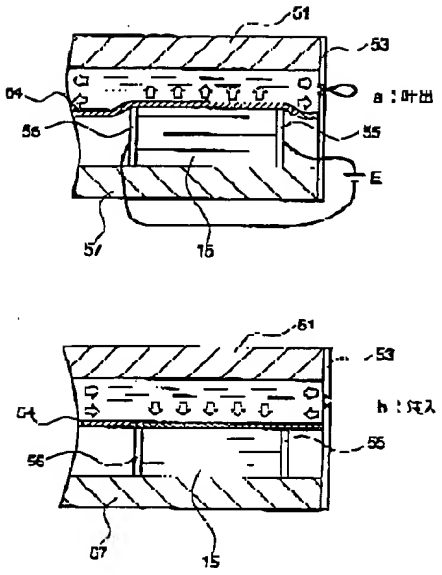
c：印加電圧−E

【図7】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53
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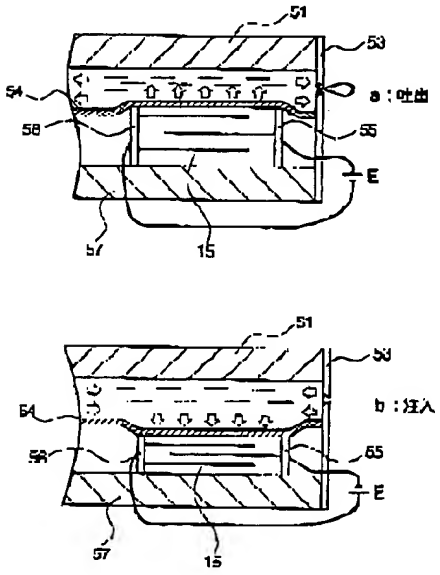
【図8】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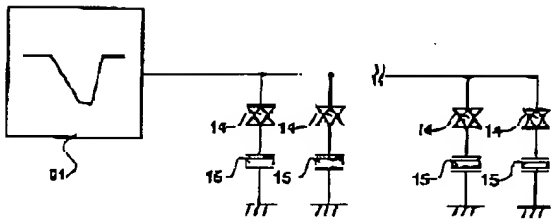
【図13】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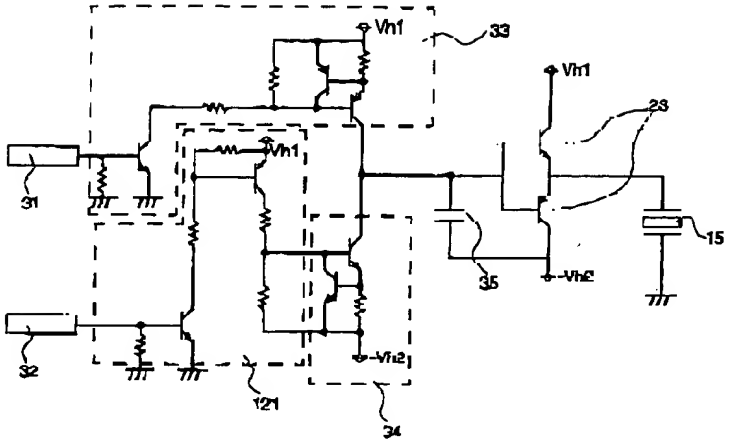
【図12】



JAPANESE [JP,10-235863,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] It is the ink jet head drive circuit which the electrical potential difference impressed to an electrostriction component impresses to the forward direction and hard flow to the direction of polarization of an electrostriction component in the ink jet head drive circuit which presses ink with an electrostriction component, can breathe out ink from a nozzle, and prints an alphabetic character and a graphic form in total. The ink jet head drive circuit characterized by giving the driving signal which changes to one electrode of an electrostriction component on the electrical potential difference beyond 0V, impressing the electrical potential difference beyond 0V also to another electrode, impressing an electrical potential difference to the forward direction and hard flow to the direction of polarization according to the potential difference of a mutual electrode, and making an electrostriction component expand and contract

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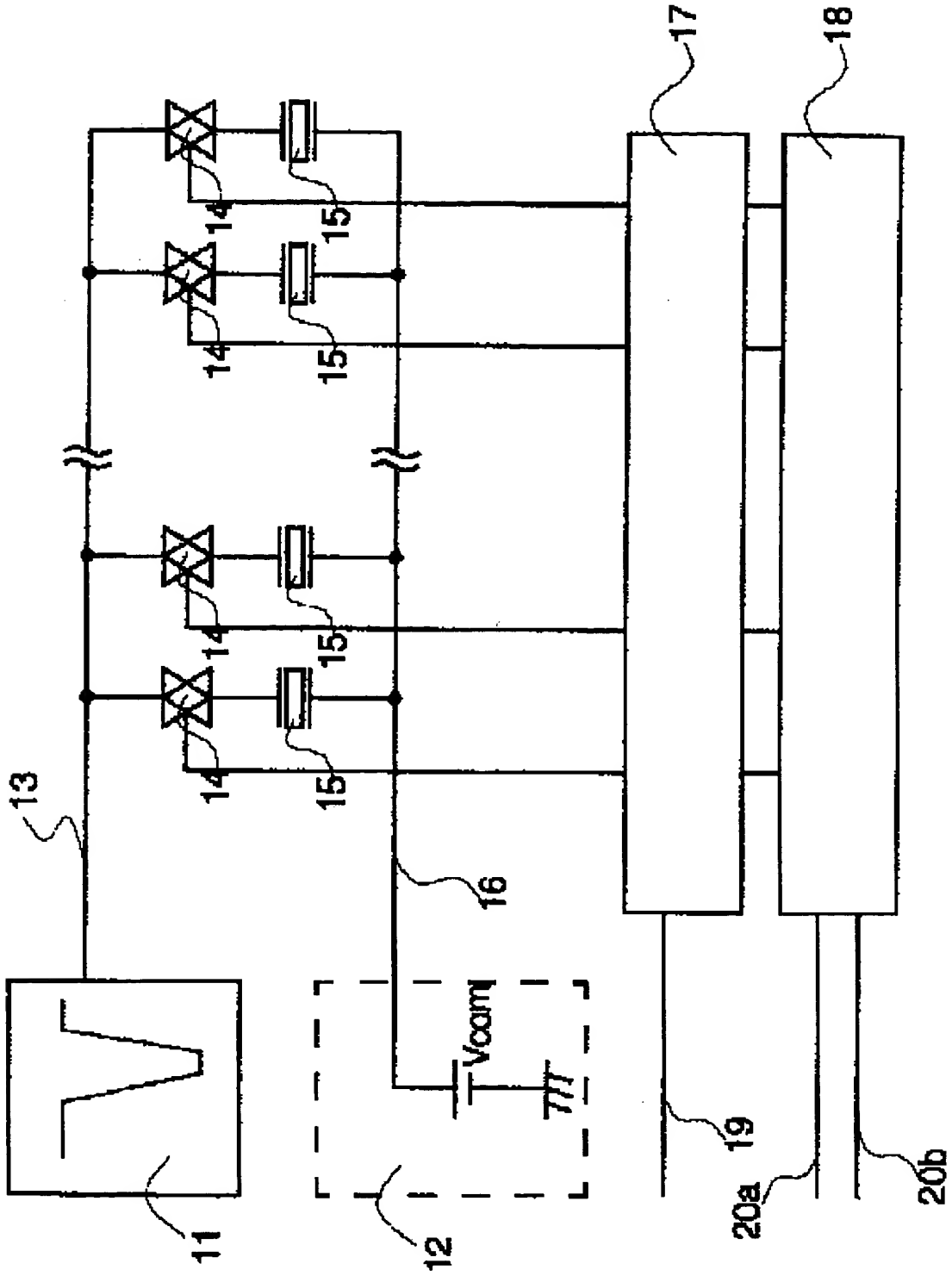
[Translation done.]


17
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Vcom
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20a
20b

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an ink jet head drive circuit.
[0002]
[Description of the Prior Art] An ink jet head is explained briefly first. Drawing 5 is an example of the structure of an ink jet head. Diaphram 54 pasted up and the electrostriction component 15 has pasted up the whole surface of the pressure room 51 where it fills up with ink on the field opposite to a pressure room. As shown in drawing, when an electrostriction component impresses a drive wave and it is impressed in the direction of polarization like drawing 6 b, the volume of elongation and a pressure room is contracted in the direction where an electrostriction component is perpendicular to an electrode, and ink is breathed out. Moreover, it is shrunken when impressed by hard flow like drawing 6 c, and a pressure room is contracted and ink is poured in.
[0003] Like [in before] drawing 7 , the regurgitation of ink and impregnation impress and lengthen a forward electrical potential difference for an electrostriction component, and are the regurgitation (a). And it is made 0V, and ink is poured in when returning to the condition that the electrostriction component is not distorted (b).
[0004] If you make it distorted also in the direction which impresses a negative electrical potential difference to an electrostriction component, and is shrunken by it like drawing 8 as compared with it, (b) and that much forward electrical potential difference can be made low. When a forward electrical potential difference is too large and it is going to extend an electrostriction component, diaphram could not finish being extended, constraint was received, and an ideal distortion could not be obtained, but, in a conventional case, there was loss over the ink regurgitation. Ink can be made to breathe out by impressing a negative electrical potential difference, making small the amount extended that much by shrinking an electrostriction component, and making small the amount of distortion from 0V, without receiving the constraint from diaphram. The following data are the difference in the ink regurgitation property at the time of impressing the electrical potential difference same in positive/negative total to the conventional drive. It turns out that a regurgitation rate differs from the diameter of a drop also on the same electrical potential difference.
[0005]
[Table 1]

駆動方法	正電圧	負電圧	駆動電圧	吐出速度	液滴径
従　来(正のみ)	４０ｖ	０ｖ	４０ｖ	６．５ｍ／ｓ	５０μｍ
本発明(正負)	３０ｖ	１０ｖ	４０ｖ	８．５ｍ／ｓ	５２μｍ

[0006] Thus, since constraint of diaphram is not received rather than you make it distorted only towards being extended, since an electrostriction component is distorted in the both directions of elongation and shrinkage and diaphram runs by impressing an electrical potential difference to an electrostriction component to the forward direction and hard flow to the direction of polarization up and down, it can be made to breathe out efficiently. The drive circuit of the conventional ink jet head which realizes the drive of the electrostriction component mentioned above is shown in drawing 9 . One electrode of the electrostriction component 15 is connected to GND (0V), and the wave generating circuit 91 which generates a drive wave is connected to another electrode. A drive wave is displaced from electropositive potential to electronegative potential to 0V (GND), as shown in drawing 10 . Since the electrical potential difference of the forward direction is impressed to the direction of polarization and, as for the electrostriction component, the electrical potential difference of hard flow is impressed at the time of elongation and electronegative potential when a drive wave is electropositive potential, an electrostriction component is shrunken. For example, so is the circuit indicated by JP,56-113473,A.
[0007] It consists of DA converter 21, an operational amplifier 22, and a transistor 23 like drawing 11 as a primary method, a drive wave is generated from a DA converter, the voltage of the wave generating circuit 91 is amplified by actual driver voltage with an operational amplifier, and current amplification is carried out by the emitter follower output of a transistor.
[0008] Moreover, since components cost goes up by the primary method mentioned above, by it, a DA converter, an op amplifier, etc. can consider the circuit which carries out charge and discharge to a capacitor like drawing 12 as the second approach. A drive wave is formed in a capacitor 35 by the charge-and-discharge circuits 33 and 34, and current amplification is carried out with a transistor 23. However, since the signal which controls a charge-and-discharge circuit is inputted into 31 and 32 on CMOS or TTL level, a level-shifter 121 grade electrical-potential-difference converter is needed, and it leads to a cost rise.
[0009] Since driver voltage just changes from negative whichever it makes it the second approach for a start, an electrical potential difference can be impressed to an electrostriction component to the direction of polarization at both right reverse.
[0010]
[Problem(s) to be Solved by the Invention] However, it is an electrostriction component, when controlling the impression to the electrostriction component of a drive wave, and un-impressing and printing an alphabetic character etc. using two or more electrostriction components like an on-demand type ink jet head, although it is satisfactory in the conventional drive circuit mentioned above when an electrostriction component is an unit

since the condition of electronegative potential occurs [a drive wave]. A switching means impression of driver voltage and by which it does not impress is needed. As a switching means, when cost, a switching rate, etc. are taken into consideration, a solid state switch is desirable. For example, although constituting a switching means from TG14 like drawing 13 is considered easily, considering cost, a mounting tooth space, etc., the configuration in IC (Integrated-Circuit) can be considered. Since IC is controlled by CPU or the gate array, it operates more than by 0V fundamentally. However, since the condition of minus potential occurs [a drive wave], naturally a minus electrical potential difference is built also over the input terminal of IC, and there is a possibility that a high current may flow from an input terminal and IC may be destroyed. Now, in order that IC cannot be used but may use discrete part, it becomes a big cost rise.

[0011]

[Means for Solving the Problem] In order to solve the above-mentioned problem, the drive circuit of the ink jet head of this invention gives the driving signal which changes to one electrode of an electrostriction component on the electrical potential difference beyond 0V, and the electrical potential difference beyond 0V is impressed also to another electrode, and according to the potential difference of a mutual electrode, to the direction of polarization, an electrical potential difference is impressed to the forward direction and hard flow, and it is characterized by making an electrostriction component expand and contract.

[0012] Since a drive wave will be [according to the drive circuit of the ink jet head of this invention] in the condition of electronegative potential to 0V to the direction of polarization of an electrostriction component in [neither of the forward direction and hard flow of] the case of electrical-potential-difference impression Being impressed by right reverse is realizable in the drive circuit of a cheap ink jet head in the direction of polarization of an electrostriction component which can use IC for the switching means which controls the impression to an electrostriction component, and un-impressing as usual, and the regurgitation effectiveness of ink goes up.

[0013]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the drive circuit of the ink jet head by this invention is explained based on a drawing. Drawing 1 is the circuit diagram showing the example of the drive circuit of the ink jet head by this invention. A drive wave is generated on the maximum printing frequency in the circuit which generates the drive wave impressed to a ****** component. The output of a drive wave generating circuit is a common line. It lets it pass and connects with the input terminal of two or more TG14. It connects with the electrode of the electrostriction component 15, and another terminal of each TG14 is carrying out ON/OFF of TG, and controls the impression of a drive wave to an electrostriction component, and un-impressing. As for control of TG, synchronizing with data transfer clock 20b, serial printing data 20a is inputted into a shift register 18 on CMOS or TTL level. The printing data outputted from the shift register are inputted into a latch circuit 17, and are memorized by the latch circuit with the latch signal 19. The output of a latch circuit is connected to the gate input of TG14, respectively.

[0014] Another electrodes of an electrostriction component are the electrode of two or more of other electrostriction components, and the common electrode 16 connected. The common electrode 16 is connected to DC power supply 12 which outputs more than 0V. The relation between the common electrode 16 and the potential of a drive wave has become like drawing 4 , and to the potential Vcom of the common electrode of an electrostriction component, when the potential of a drive wave is high, (A) is impressed in the direction of polarization in the forward direction, and when the potential of a common electrode is higher, (B) is impressed to the direction of polarization, and hard flow.

[0015] Since the output Vcom of the drive wave generating circuit 11 and DC power supply 12 of the common electrode 16 is a forward electrical potential difference beyond 0V, a

negative electrical potential difference is not inputted into TG14. Moreover, except that the DC power supply for common electrodes is needed, things, such as a minus electrical-potential-difference converter, do not need, and excessive cost does not start.
[0016] Drawing 2 and drawing 3 are the detail drawing of the 1st example of the wave generating circuit 11 of the circuit of drawing 1 , and the 2nd example. Although it is the same as the wave generating circuit 91 fundamentally shown in the conventional example, the places which are not using the negative electrical potential difference differ.
[0017] Drawing 2 is the method which used the DA converter, a drive wave is outputted by DA converter 21 in the range of 0-5v, and it is an op amplifier. The voltage is amplified by 22 at a real drive wave. The Push-Pull emitter follower circuit 23 for current amplification is connected to an output. A drive wave is displaced in the range of 0-Vh.
[0018] Drawing 3 is a method using the capacitor aiming at a cost cut. It consists of a capacitor 35, charge-and-discharge circuits 33 and 34, and a current amplification transistor 23. The charge and discharge of the capacitor are carried out in the range of 0-Vh.
[0019] Fundamentally, to the direction of polarization of an electrostriction component, the drive circuit of this invention only adds the DC power supply for common electrodes to the drive circuit which realizes the drive approach that only the forward direction impresses an electrical potential difference, and to the direction of polarization, the drive of forward reverse both directions is attained and it makes the efficient ink regurgitation possible.
[0020]
[Effect of the Invention] Since according to the drive circuit of the ink jet head of this invention in [neither of the forward direction and hard flow of] the case of electrical-potential-difference impression a drive wave will be in the condition of electronegative potential to 0V to the direction of polarization of an electrostriction component as described above Being impressed by right reverse is realizable in the drive circuit of a cheap ink jet head in the direction of polarization of an electrostriction component which can use IC for the switching means which controls the impression to an electrostriction component, and un-impressing as usual, and the regurgitation effectiveness of ink goes up.

[Translation done.]

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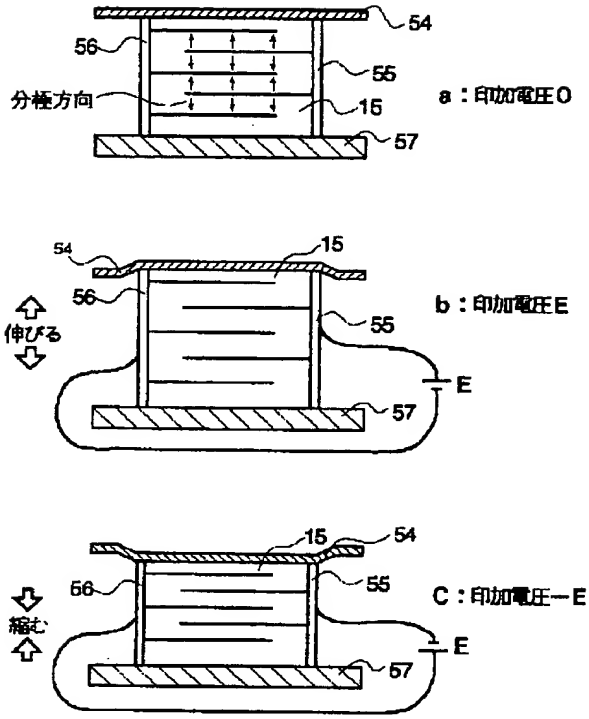
DESCRIPTION OF DRAWINGS

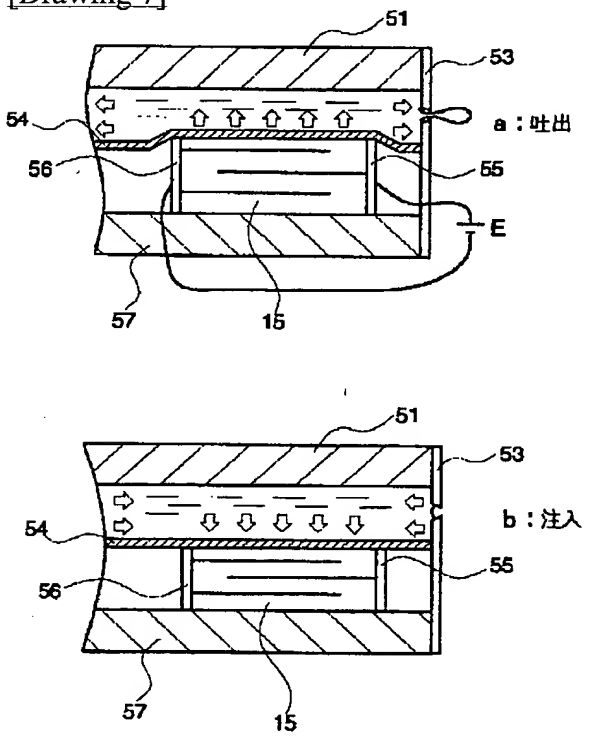
[Brief Description of the Drawings]
[Drawing 1] It is the drive circuit of the ink jet head which shows the example of this invention.
[Drawing 2] It is the 1st example of the wave generating circuit of the drive circuit of the ink jet head which shows the example of this invention.
[Drawing 3] It is the 2nd example of the wave generating circuit of the drive circuit of the ink jet head which shows the example of this invention.
[Drawing 4] One example of a drive wave of the drive circuit of the ink jet head which shows the example of this invention is shown.
[Drawing 5] It is structural drawing of the conventional ink jet head.
[Drawing 6] The situation of the distortion when impressing an electrical potential difference to the forward direction and hard flow is shown to the direction of polarization of an electrostriction component.
[Drawing 7] To the direction of polarization of an electrostriction component, only the forward direction impresses an electrical potential difference and the case where it pours in with the regurgitation of ink is shown.
[Drawing 8] To the direction of polarization of an electrostriction component, an electrical potential difference is impressed to the forward direction and hard flow, and the case where it pours in with the regurgitation of ink is shown.
[Drawing 9] It is the drive circuit of the ink jet head which impresses an electrical potential difference to the forward direction and hard flow to the direction of polarization of the conventional electrostriction component.
[Drawing 10] It is the drive wave of the drive circuit of the ink jet head which impresses an electrical potential difference to the forward direction and hard flow to the direction of polarization of the conventional electrostriction component.
[Drawing 11] It is the 1st example of the wave generating circuit of the drive circuit of the ink jet head which impresses an electrical potential difference to the forward direction and hard flow to the direction of polarization of the conventional electrostriction component.
[Drawing 12] It is the 2nd example of the wave generating circuit of the drive circuit of the ink jet head which impresses an electrical potential difference to the forward direction and hard flow to the direction of polarization of the conventional electrostriction component.
[Drawing 13] It is one example of the circuit which controls the drive of two or more electrostriction components in the drive circuit of the ink jet head which impresses an electrical potential difference to the forward direction and hard flow to the direction of polarization of the conventional electrostriction component.
[Description of Notations]
11 Wave Generating Circuit of Drive Circuit of this Invention
12 DC Power Supply for Common Electrodes

13 Drive Wave Common Line
14 TG (Transfer Gate)
15 Electrostriction Component
16 Common Electrode
17 Latch Circuit
18 Shift Register
19 Latch Signal
20a Serial printing data
20b Transfer clock
21 DA Converter
22 Op Amplifier
23 Current Amplification Transistor
24 Wave Generating Circuit Output Terminal
31 Charge Circuit Input
32 Discharge Circuit Input
33 Charge Circuit
34 Discharge Circuit
35 Capacitor
51 Pressure Room
52 Ink
53 Nozzle Plate
54 Diaphram
55 Electrode of Electrostriction Component
56 Electrode of Electrostriction Component
57 Pedestal
91 Wave Generating Circuit of the Conventional Drive Circuit
121 Level Shifter (Electrical-Potential-Difference Converter)

[Translation done.]



[Drawing 7]



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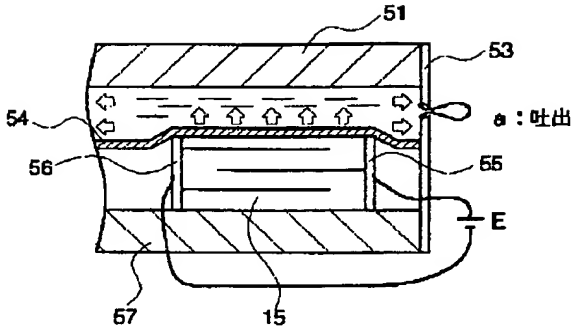

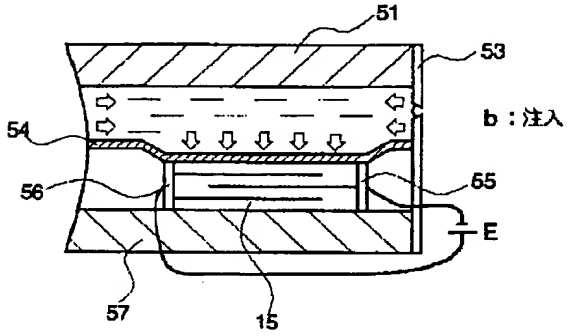

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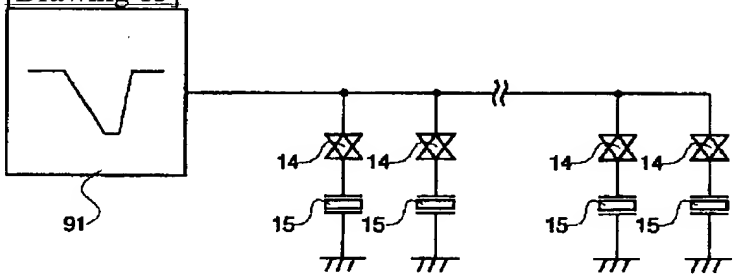

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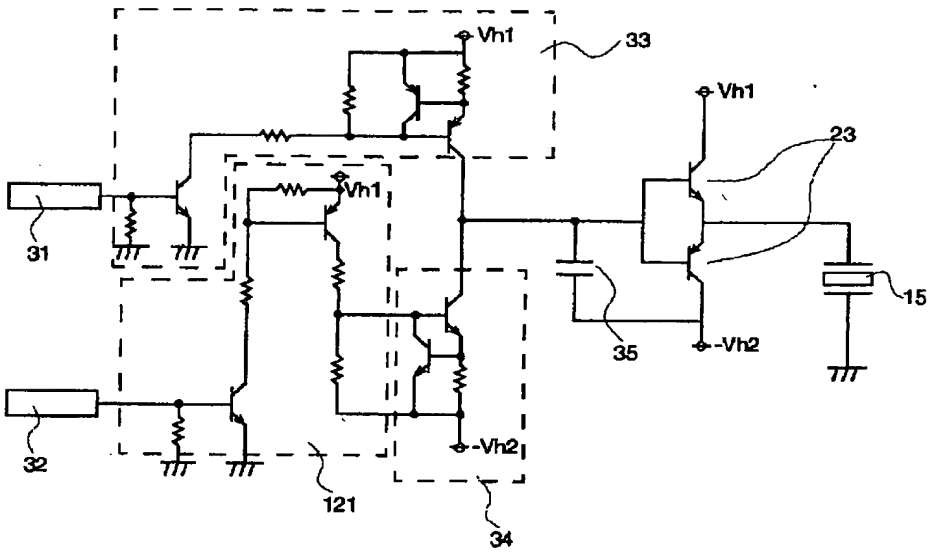

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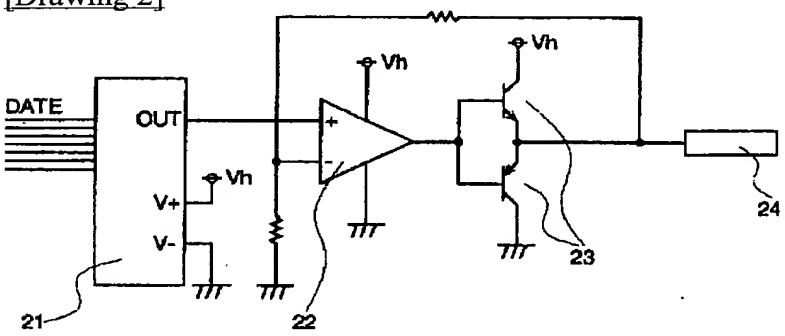
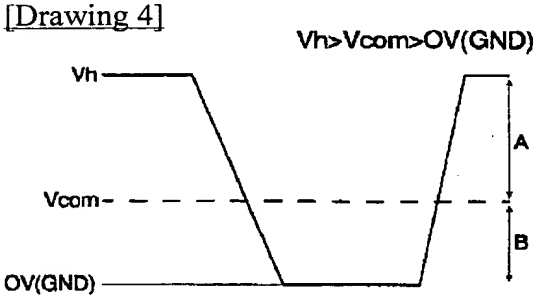
DRAWINGS

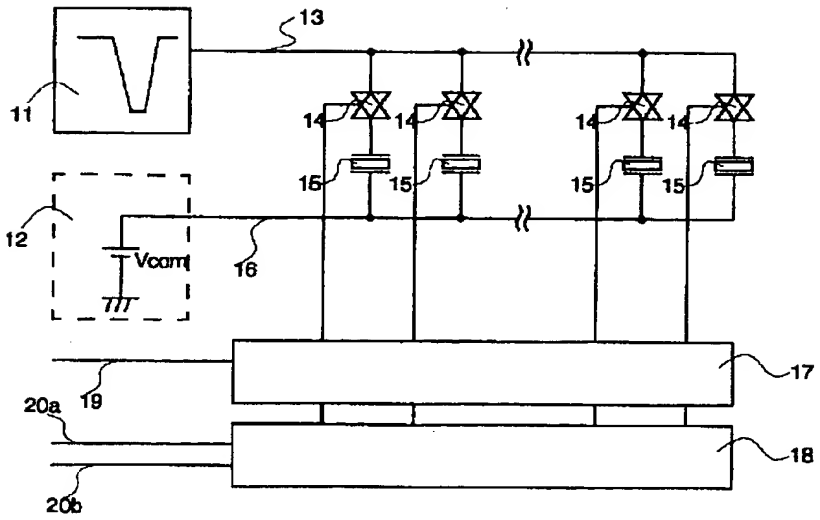
[Drawing 2]



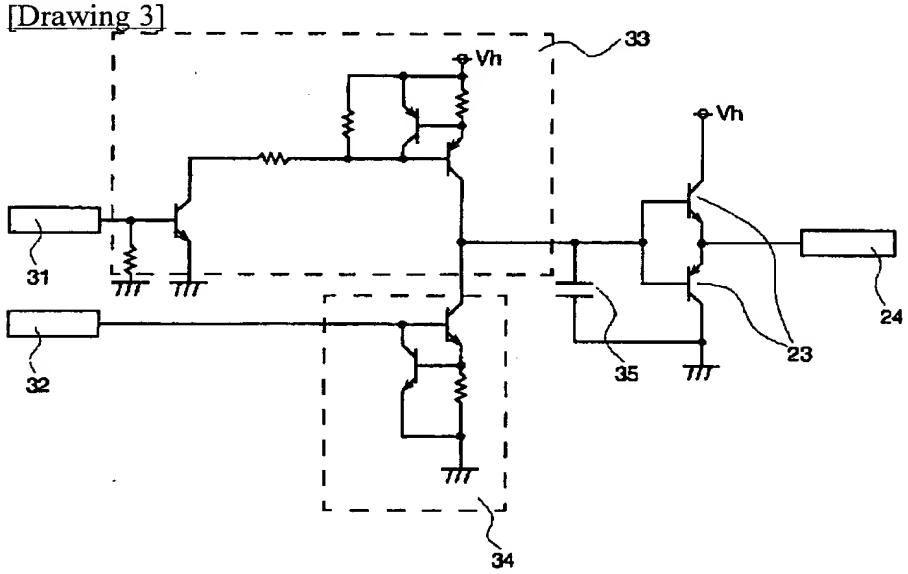
[Drawing 4]



[Drawing 1]



[Drawing 3]



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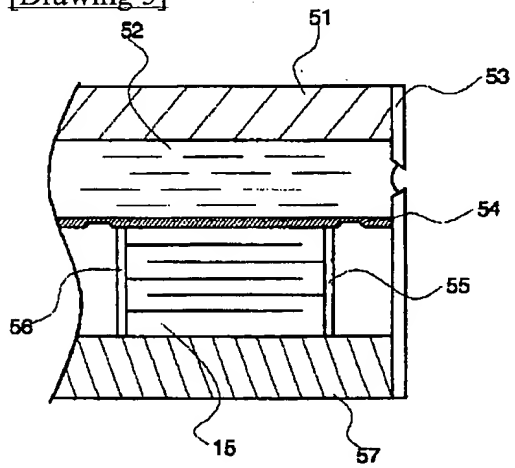

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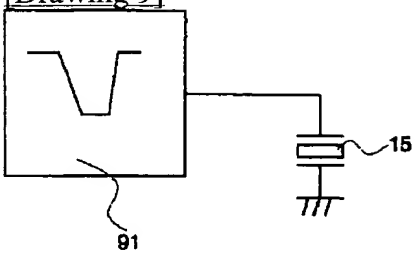

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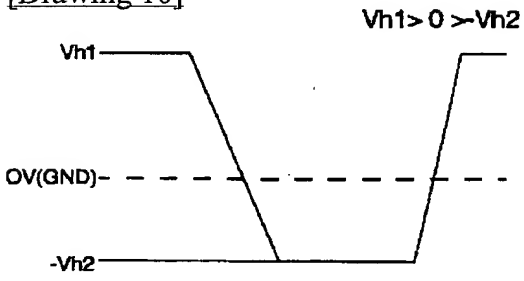
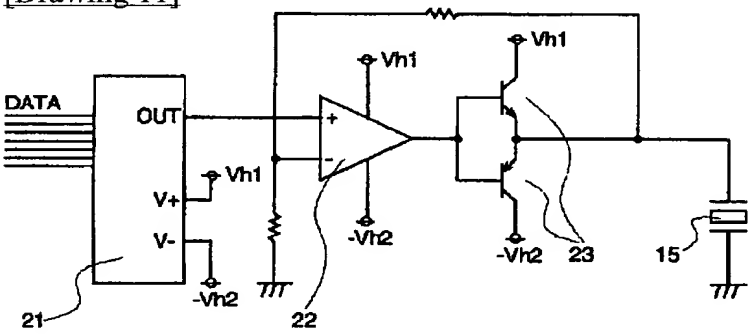


[Drawing 11]



[Drawing 6]